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The Pacific Rivers Council
Mary Scurlock, Senior Policy Analyst
C/o 10575 NW Skyline Boulevard
Portland, OR 97231
(503) 283-1395 • Fax (503) 283-3577
mscurlock@worldnet.att.net

To: **Content Analysis Enterprise Team**
USDA Forest Service
Attention: UFP
5500 Amelia Earheart Drive
Building 2, Suite 295
Salt Lake City, UT 84116
Email: cleanwater/wo_caet-slc@fs.fed.us

Re: **Comments on Proposed *Unified Federal Policy for a Watershed Approach to Federal Land and Resource Management* (February 22, 2000)**

Dt: **24 April 2000**

Pacific Rivers Council (PRC) strongly supports the development of a Unified Federal Policy to establish a consistent, high quality, science-based approach to guide federal land and resource management activities at the watershed scale. We especially support the policy's commitment to manage federal lands as a model of good stewardship.

PRC also supports the advancement of a science-based approach to assess, protect, and restore watersheds. Full implementation of such an approach will require a fundamental shift in the relationship between science and land use planning. Historically, scientific expertise has been used to implement , rather than define, land management objectives. Under current policies, land use planning and decision making is too-often based on evaluation and mitigation of impacts for individual projects. Analysis rarely tailors land use patterns to the landscape. Indeed, current policy focuses on modifying landscape processes to better suit human desires or on identifying thresholds that trigger land use restrictions. In our view, a science-based approach means that science precedes planning, so that analyses are oriented around resources rather than potential projects. This approach is more proactive than an impact mitigation approach. It requires the identification of the impacts of human actions on ecological processes and systems, then-redesigning land use and management to minimize these impacts. It focuses on causes rather than symptoms of ecological degradation.

As proposed, however, the Unified Policy does not adequately or explicitly direct this shift toward using science to determine management limitations. Without a clearer path for turning assessments into binding policy, the current proposal runs the risk of perpetuating a failed emphasis on mitigation and inadequate management practices narrowly targeted at pollution control. Such an approach would continue to overemphasize treatment of symptoms rather than underlying causes of ecosystem degradation at the landscape level.

We specifically recommend that the policy should:

- Strengthen implementation of the antidegradation mandate for all federal lands by establishing clear decision protocols to screen out harmful activities, particularly in impaired watersheds.
- Establish implementation oversight and accountability mechanisms and clear schedules for accomplishing unified policy benchmarks and objectives.
- Clarify the relationship between Priority and Special Protection Watersheds
- Clarify the intended scale for assessments and prioritization in the policy itself.
- Link the Priority Watershed Designation Process to existing federal planning mechanisms
- Establish a Unified Federal Roads Policy modeled after the Forest Service's pending initiative
- Link Special Protection Watersheds to the nondegradation standards for outstanding waters, and to state provisions for designation of Outstanding National Resource Waters

I. STRONG SUPPORT FOR GOALS OF POLICY

Pacific Rivers Council strongly supports the six primary goals of this policy:

1. Use a consistent, science-based approach to managing lands and resources. Although some regions of the country are implementing similar ecosystem assessment tools, there is no explicit set of protocols that all agencies have committed to use nationwide.
2. Identify specific watersheds where resources will be focused. This goal recognizes that institutional resources are limited and that there are valid ecological and social factors which can and should be used to prioritize federal actions
3. Base land use decisions on watershed assessments. This goal essentially ensures that the science-based approach adopted in the first goal actually is connected to management decisions.
4. Collaborate with governmental, tribal and private stakeholders to implement the policy. Federal lands and facilities have a broad and diverse constituency that can assist in the full implementation of this policy. Any exercise in policy alignment will require clear communication among affected parties to create a common understanding and common goals.
5. Meet responsibilities under the Clean Water Act. PRC believes that federal lands and facilities can and should lead the nation in protection and restoration of aquatic ecosystems.
6. Actively ensure that federal lands and resource management actions are consistent with all applicable water quality requirements. This goal correctly recognizes that vigilance is required to ensure that obligations are given more than lip service and that a strong commitment is needed to ensure that the good intentions of this policy translate into change on the ground.

We note that each of the six goals can and should be accomplished under the auspices of existing environmental laws, including but not limited to the Clean Water Act, the primary goal of which is maintenance and restoration of the ecological integrity of our nation's waters.

Pacific Rivers Council has long emphasized the special role federal land management plays in the conservation and recovery of aquatic ecosystems in this country. Because these lands provide most of our best aquatic habitats, they are the reason that many imperiled species have avoided extinction. But they, too, are threatened and degraded. We also have supported the watershed-based assessment of ecosystem condition, functions, and processes. This approach naturally engenders the identification of watersheds of particular ecological significance and the prioritization of these areas for protection and restoration actions.

II. RECOMMENDATIONS TO STRENGTHEN POLICY

We are aware of the challenges presented by this attempt to align numerous federal agencies with different mandates and missions, and understand that the broad reach of the policy justifies a certain amount of general language. However, we suggest that more specificity be provided to clarify the parties' mutual understandings of what the proposed agreement intends.

A. Specify Need to Establish a Common Understanding of Key Clean Water Act Obligations within the Federal Family: Strengthen Implementation of the Antidegradation Mandate for All Federal Lands

Federal management decisions are vitally linked to the protection and restoration of a vast number of this nation's rivers, lakes, and streams. The current widespread impairment of aquatic systems largely is caused by past and continuing federal land management actions. At the same time, these lands harbor many of the last best habitats for a multitude of aquatic and riparian-dependent species. The importance of protecting and restoring these watersheds to the ecological future of this country cannot be overstated.

With respect to polluted runoff -- including all forms of impairment to aquatic ecosystems from dispersed land use activities -- we have yet to meaningfully implement the Clean Water Act's mandate to "maintain" the chemical, physical, and biological integrity of the nation's waters. Rather, we allow the incremental degradation of our watersheds through public and private land use decisions, which do not follow the Clean Water Act's mandates against further degradation.

A single overriding principle must guide watershed priorities: first, do no harm. Federal agencies must refuse to engage in activities that will degrade water quality. Further, no activity should proceed without an independent finding that polluted run-off which degrades aquatic integrity will not result from the project. This approach is consistent with the presumption against degradation of existing water quality which currently applies to all waters regulated by the Clean Water Act but which is seldom given explicit recognition in routine management decisions. The Clean Water Act clearly intends that where water bodies are impaired, further degradation should not be permitted to continue. Where water bodies meet or exceed established standards, it is presumed that degradation is not permissible without a finding that the

circumstances justify such degradation.

Currently, there is no commonly understood decision framework which federal managers use when making decisions which may affect aquatic ecosystems. This situation is of particular concern in places where aquatic species are not protected under the Endangered Species Act so there is no interagency decisionmaking process motivated by the need for consultation.

We strongly recommend that as part of the Unified Federal Policy there be developed a nationally applicable policy which establishes a protocol for management decisions that may cause water quality impairment. The emphasis of such a protocol should be on decisions affecting impaired waters, as indicated by a state 303(d) list or by other information indicating that protected uses are not being fully maintained. This direction should clarify that management changes may need to be made on waters impaired by nonpoint pollution from federal land uses prior to the formal approval of TMDLs and associated implementation plans.

The Unified Policy should strengthen the Clean Water Act's nondegradation mandate and memorialize the federal agencies' commitment that they will not authorize new activities which threaten to degrade water quality and that they will cease activities which will further degrade or permit continued levels of existing degradation on degraded streams. (See e.g. 303(d) protocol being implemented by MOU in Region 10). Through the designation of special protection watersheds the federal agencies will also collaborate with states to implement Tier III of the nondegradation mandate to identify and protect Outstanding National Resource Waters. (See Section H for further discussion of nondegradation issues.)

B. Implementation Mechanism Missing: First Steps, Oversight, and Accountability

The currently proposed policy does not appear to provide a clear path toward reaching its goals. The policy should include enough description of an Implementation Plan that the partner agencies will know what they are expected to do the day after the policy is signed.

As part of outlining the implementation plan, we suggest that some additional framework should be established which assigns responsibility for oversight and implementation of the policy at the appropriate levels of government. Perhaps a national interagency UFP Progress Team should be established to provide national oversight. This body would essentially be the manifestation of the collective "we" in the proposed policy

In order to establish meaningful accountability for implementation of the proposed policy, the policy itself must set some clear indicators which can be used to mark progress toward meeting overall goals. If the policy itself does not establish benchmarks for success -- including timelines for action -- then at least a process should be identified for establishing these missing elements.

We note that there is reference to the development of a schedule for assessment of priority watersheds and the identification of resources needed to assess all other watersheds. A 10-year assessment cycle for priority watersheds is established, which seems reasonable. But while a 10-year reassessment cycle may be appropriate for the longer term, we suggest that the initial round of identification and assessments should be completed in no less than 5 years from the date the

policy is finalized. The shorter timeline recognizes the importance of removing threats to priority watersheds in order to prevent further species declines and listings and to maximize recovery chances for many imperiled species whose future is disproportionately dependent on federal watersheds for survival. Additionally, priority watershed assessments already have occurred in many regions (e.g., the Pacific Northwest, Interior Columbia, and the Sierra Nevada) which will necessarily lessen the onus of initially identifying high quality watersheds on federal lands.

Many components of the policy lack any timeframe, including but not limited to:

Part A:

- Define and implement interagency guidelines for delineation of watersheds. *(Isn't this something that can be done on a fairly short timeline?)*
- Develop and test watershed assessment procedures under these guidelines. *(Can we set goals for extension of the policy to all agencies in all regions of the country?)*
- Develop a framework for classifying the condition of watersheds with significant federal lands and resources. *(The policy calls for a schedule to do the assessments, but not for establishing the assessment framework itself).*

Part B:

- Process for identification of priority and special protection watersheds
- Identification of priority watersheds and special protection watersheds. Implementation of Special Protection for Special Protection watersheds
- Implementation of pollution prevention and controls that satisfy legal requirements (*We realize this is the broad overall national goal behind this policy, but perhaps the federal agencies could set a goal of 100% compliance within a time certain, such as 5 years? This will set the pace for nonfederal actors to meet goals*).

Part C:

- agency review of rules, policies and procedures for compliance with applicable requirements.

Part D:

- development of a common watershed assessment framework
- development of formal agreements to clarify responsibilities with states, tribes and local governments
- develop and implement a coordinated monitoring and evaluation approach

Aside from lacking timelines, many of the above actions may not have tangible policy impacts if unless they are formally linked to federal planning processes and/or memorialized in rules. For example, how can we be certain that "interagency guidelines" on watershed delineation's and assessments will be applied conscientiously if they are not formally established as binding procedure and policy? Likewise, what effect will designation of priority and special protection

watersheds have if these are not formally linked to the federal land use plans, which guide federal actions as a matter of law? These concerns are not trivial details – how they are addressed will make the difference between whether this policy is merely a political exercise in hand waving or a substantive effort to improve natural resource conditions.

C. Priority and Special Protection Watersheds

All aquatic resources and watersheds on all public lands should be valued and managed as important natural resources. Nonetheless, there are valid fiscal, ecological, and public health and welfare reasons for the establishment of priorities.

The proposed policy sets up two competing priority lists. One is a list based on the "conditions" in the watershed. The other is a list based on special values. Presumably, the "conditions" list would be prioritized from worst to best. This would provide the basis for funding priority—"to focus efforts to address the highest priority problems." The "special values" list would be prioritized from highest to lowest to provide a basis for special protection priority. But the interface between these two lists is unclear in the policy.

A federal policy for managing watersheds should focus on conservation priorities. "Special value" watersheds should have priority both for protection and, where appropriate, for restoration activities in order to maximize investment value. Top priority should be given to watersheds where the risks associated with federal management activities are substantial. Indicators of substantial risk might include occurrences of natural heritage species and other species of concern, public interest (including fishing and other recreation use), drinking water sources, biological distinctiveness, erodible soils and steep slopes, and native aquatic/riparian diversity. Where watershed conditions are good, the policy should indicate rigorous levels of protection. Where watershed conditions need corrective action within this class, the policy should indicate funding priority for restoration.

D. Criteria for Special Protection Watersheds

While it may be premature to introduce specific criteria which will be brought to bear in identifying a watershed as in need of special protection, it is appropriate to list the general criteria. For example, we assume that watersheds of critical significance to the recovery of imperiled aquatic species (whether listed under the Endangered Species Act or not) would fall into this category. Similarly, watersheds meeting state criteria for Outstanding National Resources waters likely would be candidates.

Specific suggestions for the type of information that should be brought to bear in determining special protection watersheds are included in Attachment A.

It still is unclear whether the criteria for special protection watersheds will qualify for special protection notwithstanding a 303(d) listing in all or part of the watershed. The "Questions and Answers" indicates that special protection watersheds "may require restoration work," so it appears that impairment does not disqualify the area, but this should perhaps be explicit in the policy-- a recognition that watersheds can be both "in need of restoration" and "pristine or

sensitive." The reality is that most, if not all, watersheds in the country, particularly at larger scales, exhibit some of the qualities of an impaired watershed. However, certain watersheds are particularly critical to the conservation of imperiled species. The challenge here is to overlay a new set of priorities on these watersheds which protects vital ecological priorities.

E. Incorporation of Designation Process into existing federal programs and processes

The policy does not clearly articulate how the watershed prioritization process and special protection watershed designations will be integrated into existing federal programs and processes. We suggest that the designation of special protection watersheds should be addressed in at least four ways:

* Special protection watersheds should be addressed immediately upon designation in all federal permit renewals and issuances which may affect the physical, chemical, or biological integrity of the nation's waters, including but not limited to federal licenses and permits subject to Section 401 certification by states.

* In regional ecosystems plans, such as the Sierra Nevada Ecosystem Management Project and the Interior Columbia Basin Ecosystem Management Project and other similar plans.

* In revisions of national forest plans and BLM district resource management plans.

* In Memoranda of Agreement with States establishing or continuing designated management agency status for federal lands management agencies for water quality standards compliance.

F. Clarification needed on scale for assessments and prioritization

It is unclear the scale at which watersheds will be prioritized and assessed. The "Questions and Answers" on the policy indicates that 50-200 square miles is the range targeted for assessments. This information should be in the policy, even if it is only there to clarify intent to the reader. We support what appears to be the intent of the proposal to use larger-scale UWA to identify priority and special protection watersheds at the ecoregional level, or at least over a single large basin (4^{th} order HUC) at a time. The priority/special protection designations should have meaning with reference to the regional or ecoregional context in which it occurs.

G. Unified Federal Policy on Roads

Even before Priority and Special Protection watersheds are identified and assessed, it is safe to say that the most significant threats facing a majority of these watersheds will derive from roads. Therefore, it is appropriate for this policy to explicitly recognize the significant threat that roads, new and old, pose to watershed health on federal lands. Notwithstanding the outcome of the pending USDA Forest Service initiative, the Unified Federal Policy can and should explicitly make findings about the need to address road-related threats in all federally managed watershed nationwide.

Given the pre-eminence of roads as a threat to water quality and overall watershed health, it is logical for the Unified Federal Policy to include the following direction:

1. Pending the completion of watershed assessments and priority/special protection watershed designations, establish a presumption against the building of new roads on federal lands, with extremely limited exceptions. There are already more roads on our National Forests alone than in the entire interstate highway system. On these roads there is more than an $8 billion backlog in maintenance of the current road system. It is therefore logical that the focus of roads management be on reversing the ecological damage caused by existing unneeded roads and so-called "needed" roads.
2. Road-building, operation, and maintenance decisions must put ecosystem needs first and resource outputs second. The minimum road system cannot continue to be defined as what is "needed" to fulfill current land use plans because these plans are not most current based on watershed assessments and ecological sustainability, with a few exceptions. Rather: (1) Resource objectives for federal lands should be revised to reflect what is known about ecological limits – including limits on both the location and number of road miles; (2) Target dates must be established for full-scale revision of land use plans nationwide; and (3) In the meantime, road management decisions must be based on ecosystem protection and restoration needs, not on the need to meet existing planned outputs.

3. A specific goal of watershed assessments should be to identify areas that simply are not suitable for roads. There is substantial scientific documentation to support the premise that roads simply are not appropriate in some areas -- riparian areas, unstable slopes, sensitive watersheds, wildlife migration corridors, for example. Neither the agency nor the public need waste its time considering ecologically inappropriate options.

4. Assessments must also address road issues specific to off-road vehicle use. System off-road vehicle "trails", as well as "user created roads" cause enormous ecological damage. Many of these trails are in the worst possible locations, running alongside and through streams. The policy must bring these recreational uses inside the same ecological sideboards as passenger vehicle periods.

These and other recommendations related to roads and federal lands are included in Pacific Rivers Council's National Forest Roads Briefing Materials (March 2000) (attached and available from www.pacrivers.org)

H. Link Special Protection Watersheds to Nondegradation Standard and to State Provisions for Designation of Outstanding National Resource Waters

The Unified Policy should make it clear that special protection watersheds are intended to receive the level of protection anticipated by "Tier 3" of the antidegradation policy according to current regulations and EPA guidance.

In the name of collaboration and policy alignment, we further suggest that designation of special protection watersheds on federal lands should be tied to state National Resource Water ("ONWR" or "ORW") programs. This is recommended notwithstanding the fact that federal designations of these watersheds may take place without state action under the independent authority vested in the federal agencies under the various federal lands statutes. The federal agencies could agree to avail themselves of whatever state designation processes exist in the various states, including but not limited to administrative and state legislative nominations processes. Links to state antidegradation policies may be particularly important for federal special protection waters downstream of nonfederal ownerships. Management of such federal lands with the goal of no degradation of water quality could easily be stymied if nonfederal portions of the watershed are not also managed to meet the same standard.

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ATTACHMENT A
Suggested Criteria for Establishing Priority Watersheds

The scope and magnitude of aquatic ecosystem impairment is broad and deep, but it is within our capabilities to set priorities on the landscape based on two fundamental principles. First, the continued existence of numerous aquatic and riparian-dependent species depends on the conservation of "key" watersheds that provide high quality habitats. Many of these currently exist primarily on federal lands, most of which are in the eleven western states. Second, prevention of impairment (aside from being biologically imperative) is more effective and less costly than post-hoc restoration.

The proposed policy is consistent with a rational prioritization which targets: (1) watershed providing public drinking water supplies; (2) water quality limited streams which are providing, or recently provided, habitat for listed and at risk salmonids and other aquatic species or which are otherwise ecologically significant; and (3) waters with high potential to provide habitat to support listed or at-risk native fish and other riparian dependent or aquatic species.

Criteria for Prioritization of Federal Lands Watersheds: Priority Watersheds and "Watersheds for Special Protection"

The science is clear: the fundamental building blocks of any aquatic conservation strategy are the remaining areas of healthier habitat. The recovery of aquatic ecosystems depends on the protection and restoration of these areas. Numerous existing federal policies and independent scientific assessments have identified these areas at the watershed level, variously calling them "Aquatic Diversity Areas" or "Key Watersheds," "Priority Watersheds" "Salmonid Strongholds." Included within most of these watersheds are the few remaining roadless areas.

PRC has long supported the identification and protection of biological refugia at multiple scales, including watersheds, subwatersheds and biological hotspots exemplifying the best functioning ecosystems and habitat for native fish and other aquatic life and, where possible, essential corridors linking these habitats.

The small streams at the headwaters of river systems – a majority of which are on federal lands in the West -- are the most vulnerable to human disturbance (especially timber harvesting, road building, grazing, and related activities) because they respond dramatically and rapidly to disturbance to their riparian areas and steeper slopes. Even where inaccessible to fish, these small streams provide high levels of water quality and quantity, sediment control, nutrients, and wood debris for downstream reaches of the watershed. Intermittent and ephemeral headwater streams are therefore often largely responsible for maintaining the quality of downstream riverine processes and habitat for considerable distances.

Biotic refuges (refugia) are discrete riverine areas which maintain habitat conditions conducive to at-risk species. Refugia can include the remaining relatively undisturbed smaller headwater watersheds that also provide some degree of ecological "control" for the system. As such, these refugia are often the linchpins of the existing health of riverine systems for considerable distances downstream, and for conservation of biodiversity.

The remaining undisturbed headwater streams also constitute many of the remaining benchmark streams with which to compare and monitor stream ecosystems over time. In many riverine systems, preserving the integrity of both the biotic refuges and fully intact benchmark headwater watersheds may be the only hope of maintaining ecosystem and species health. Restoration of many of America's riverine systems may prove impossible unless these areas are quickly protected and secured.

In the northwest, the focus has been on protection of the remaining native salmonid populations, which are disproportionately dependent on certain habitat pockets for short term survival and, therefore, long term recovery. We have supported the management of these areas for the primary purpose of salmonid conservation until salmonid recovery trends are established and substantial habitat restoration in other areas has occurred. These areas shall be prioritized for active restoration resources directed at the amelioration of internal threats to refugia, including mid-slope and riparian road networks with inadequate drainage and channel crossings, unmaintained older logging roads and abandoned railroad grades etc.

Suggested Identification Criteria

Refugia span a wide range of sizes and forms (Frissell 1998; Sedell, 1990) and may be identified either at the watershed scale (20 square miles and larger) or subwatershed scale (focal refugia) or at the valley floor scale (nodal refugia). (Frissell 1998; Frissell 1996).

At the watershed level, priority areas may be identified based on their importance for key native species. On the Pacific Coast and the Interior West, these are mostly wild native salmon, steelhead and trout. Many of the large watershed-level aquatic refugia west of the Cascades have been identified as Key Watersheds in the Northwest Forest Plan, and most of the land base within these larger refugia is in federal management. (However, the substantial private forestland portions of these areas have not been formally recognized in state policies as warranting special management). Additional watershed-level refuges have been identified in independent assessments, including Huntington and Frissell, 1997 (northwest Oregon), Dewberry 2000 in press (Columbia Pacific region); Williams and Spooner, 1998 (Sierra Nevada); (Frissell, 1997)(eastern Washington); Frissell 1998 (Olympic Peninsula and Hood Canal); Hitt and Frissell, 1999 (western Montana).

Key criteria for focal refugia include:

* The watershed serves as a zone of convergence for reproductive aggregation, spawning, egg incubation, and rearing of numerous life history types of salmon within the larger drainage basin. It exhibits some degree of hydrologic independence from the remainder of the stream network so that habitats within it may be spatially sheltered from the cumulative impacts of human alterations or adverse natural events located elsewhere in the basin. (Frissell 1998).

* The watershed supports a sensitive salmonid population that is vulnerable to disturbance and which requires immediate protection to maintain genetic or life

history diversity. These may include critical areas for known sensitive species or stocks or stocks known to have unique life history or genetic traits; populations near the extreme edge of the range of a more widely distributed species; highly abundant populations that may be critical for sustaining production or seeding habitats within a watershed or in adjacent areas. (Oregon AFS 1993; Allendorf et. al. 1997).

* The watershed exhibits high numbers of native fish species and is relatively unaffected by species introductions or stock transfers, such that it could serve as a genetic refuge for indigenous fish assemblages. For example, in watersheds currently occupied by anadromous salmonids, sub-watersheds responsible for 75% of the salmonid production of the watershed should be designated as salmon refugia. (Dewberry 1999, in press). (It is estimated that this area will comprise from 5-25% of the area currently occupied by anadromous salmonids).

For nodal refugia, key criteria are:

* The area contains habitats or streams important to the healthy ecological functioning of a watershed, e.g. critical to maintaining water quality and optimum instream temperatures. These often include small tributaries or individual valley segments with localized islands of floodplain forest cover and naturally complex channel form and behavior. Frissell 1998a.

* The area serves as a corridor providing vital connections between rearing and spawning areas, between disjunct or potentially disjunct populations, or between existing areas of protection.

In some areas refuges may be identified by assessing existing information (particularly spawning surveys conducted by state fishery agencies) and by using a rapid snorkeling technique where information is lacking and to validate prior data. (Dewberry 1999 in press). The snorkeling technique used by Dewberry accurately characterized juvenile salmon abundance and distribution over a wide area, particularly for coho salmon and adequately for steelhead and cutthroat trout. Modifications to this method may be necessary for chum and chinook. (Dewberry 1999, in press.)

Linkages to lands outside of federal management must be made through other parts so the Clean Water Action Plan. For example, on the federal lands of eastern Oregon, a scientific panel in 1993 recognized that protection of headwater Aquatic Diversity Areas is required to prevent more habitat loss and to secure the few remaining refugia for many remnant native fish stocks and assemblages. (Henjum et. al. 1993). But protection of only headwater and small stream refuge areas was not considered enough "to sustain migratory populations or restore the productivity in eastside watershed of native cold-water species like salmon or bull trout. Id. Critical reaches and habitats on large streams and rivers must also be identified and protected based on criteria, which recognize their high potential for restoration. These areas can then be targeted in subsequently developed restoration plans.

Special Protection of Functionally Critical Areas within Watersheds also should be Part of the Federal Lands Strategy (nodal refugia, below)

The proposed policy properly addresses the need to recognize protection and restoration priorities at the watershed level. However, relatively intact watersheds are not the only refuges that sustain biota in disturbed systems. At least two other kinds of refuge habitats are important. These tend to be located in downstream, low-elevation areas that have experienced a long history of human disturbance. (These areas are less frequently federally managed, but some are). Typically these are smaller habitats that are unusually resilient or resistant to the effects of disturbance; although fragmented, at least some of their natural diversity and function remains relatively intact. Occasionally they are habitats that have escaped severe disturbance by chance or by virtue of unusual ownership history. Estuaries and forested floodplain reaches of rivers can function as downstream refugia, providing islands of high-quality habitat for downstream-dependent species and life stages and serving as sources of colonists to upstream reaches. Also important and more widely distributed are small-scale or "internal" refuges, such as the hyporheic zone of a floodplain river reach, a floodplain wetland, a cold-water plume at a tributary mouth, or a groundwater-fed spring. Areas rich in these kinds of hot spots may be critical to sustaining the current complement of species, and cultivating the maintenance and propagation of such habitats will be a necessary component of a successful restoration program. (Sedell et. al. 1990; Frissell 1993).

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